CAGE NUT ASSEMBLY HAVING A FLEXIBLE CAGE

CROSS-REFERENCE

This patent application claims the benefit of domestic priority of United States Provisional Application Serial No. 60/432,165, filed December 10, 2002, and entitled "Cage Nut Assembly Having a Flexible Cage".

BACKGROUND OF THE INVENTION

The present invention relates to a cage nut assembly.

Cage nut assemblies are well known in the art and provide a useful function in that they are able to hold a threaded nut at locations in a frame that are difficult or in some cases impossible to reach with a tool. Cage nut assemblies are used in vehicles for seat attachments, radiator attachments, chassis to drive train attachments, and for any other nut application that requires the nut to have an "X" and "Y" axis adjustability to accommodate tolerance variations and enable engagement thereof by a male threaded fastener.

Problems have arisen in conjunction with prior art cage nut assemblies. One problem occurs after the cages of the cage nut assemblies are welded to a mating surface, such as an automobile frame. After the cages are welded to the automobile frame, the frames are sent through an e-coat or ELPO bath that adds a corrosion or paint coating thereto. In cage nut

assemblies where the underside of the nut is capable of sitting flat on the cage, the nut and cage may stick together when the e-coat or ELPO bath is applied thereto, thus removing the intended float/adjustability of the nut within the cage.

At least two known and separate United States patents have acknowledged this problem and have attempted to provide cage nut assemblies which solve the problem. United States Patent No. 5,096,350 discusses the use of any item attached to either the cage or the nut, or to a third part positioned between the nut and the cage, that flattens out when the nut is torqued into place. This item allows for the stand-off needed during the e-coat and provides for a solid joint when the nut is torqued into place. These flattenable projections either on the cage or the nut, or the addition of a third part with the flattenable projections thereon, provide high manufacturing costs to the cage nut assembly.

United States Patent No. 5,630,686 discusses the use of plastic rings staked at the top of a nut extrusion that hold the nut up off of the cage floor or mating panel, thus removing the possibility that the e-coat will allow the parts to stick together. The plastic rings are flexible enough to allow a solid joint to take place when the nut is lowered to interface with the cage floor or mating panel when the nut is torqued down. This patent requires the plastic rings in order to perform the desired function. The addition of the plastic rings to the cage nut assembly is expensive and the rings sometimes disengage from the assembly when the nut is torqued into place thus causing a buzz, squeak rattle ("BSR") issue with customers.

Thus, there is a need for a cage nut assembly which does not allow the nut to become stuck to the cage during the application of an e-coat or ELPO bath and which overcomes the disadvantages of the aforementioned United States patents which have attempted to solve this same problem.

OBJECTS AND SUMMARY

A primary object of an embodiment of the present invention is to provide a cage nut assembly which reduces the possibility of the nut sticking to the cage or workpiece when an e-coat or ELPO bath is applied thereto.

Another object of an embodiment of the present invention is to provide a cage nut assembly that has strong joints between the nuts and the cages after the nuts are torqued into place.

Yet another object of an embodiment of the present invention is to provide stand-off features on the nut which will reduce the amount of bearing surface interface between the cage and nut, before the nuts are torqued down.

Another object of an embodiment of the present invention is to provide a cage nut assembly where the nut is allowed to float within the cage after coating of the mating surface, which the cage is attached to.

Still another object of an embodiment of the present invention is to provide a cage nut assembly which requires less manufacturing costs in comparison to cage nut assemblies of the prior art.

Yet another object of an embodiment of the present invention is to provide a cage which is capable of supporting a nut off of a bottom wall of the cage or a mating surface prior to the coating, and which is flexible to allow the nut to be torqued down against the bottom wall of the cage or a mating surface after the coating.

Briefly, and in accordance with the foregoing, the present invention provides a cage nut assembly having a nut and a cage. The nut has two plates and a cylindrical member connecting the plates together. A threaded aperture extends through the nut. The cage has a base portion having an aperture therethrough and a pair of flexible arm portions which are

capable of supporting the nut off of the base portion of the cage. Once the cage nut assembly is formed, the cage is welded to a workpiece. The workpiece is then sent through an e-coat or ELPO bath. As the flexible arm portions of the cage support the nut off of the base portion of the cage, the possibility of the nut being stuck to the cage is reduced. A fastener is then inserted through an aperture of the workpiece, through the aperture of the base portion and into the aperture of the nut such that the fastener is threadedly engaged with the nut. As the fastener is torqued down, a force is applied to the nut such that the arm portions of the cage flex and allow the nut to come into contact and be secured against the base portion of the cage.

BRIEF DESCRIPTION OF THE DRAWINGS

The organization and manner of the structure and operation of the invention, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawings wherein like reference numerals identify like elements in which:

FIGURE 1 is a perspective top view of a nut of the cage nut assembly in accordance with an embodiment of the present invention;

FIGURE 2 is a partially-broken away bottom view of the nut of the cage nut assembly in accordance with an embodiment of the present invention;

FIGURE 3 is a perspective top view of an alternative nut of the cage nut assembly in accordance with an embodiment of the present invention;

FIGURE 4 is a partially-broken away bottom view of the alternative nut of the cage nut assembly in accordance with an embodiment of the present invention;

FIGURE 5 is a perspective view of a cage of the cage nut assembly in accordance

with an embodiment of the present invention;

FIGURE 6 is a perspective view of the cage nut assembly in accordance with an embodiment of the present invention prior to the cage supporting the nut off of a bottom wall of the cage;

FIGURE 7 is a perspective view of the cage nut assembly in accordance with an embodiment of the present invention with the cage supporting the nut off of the bottom wall of the cage;

FIGURE 8 is a perspective view of the cage nut assembly in accordance with an embodiment of the present invention with the cage supporting the nut off of the bottom wall of the cage and with the nut having floated toward a sidewall of the cage, relative to the nut illustrated in FIGURE 7;

FIGURE 9 is a perspective view of the cage nut assembly in accordance with an embodiment of the present invention being connected to a workpiece by a fastener; and

FIGURE 10 is a side-elevation view of the cage nut assembly in accordance with an embodiment of the present invention being connected to the workpiece by the fastener.

DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENT

While this invention may be susceptible to embodiment in different forms, there is shown in the drawings and will be described herein in detail, specific embodiments with the understanding that the present disclosure is to be considered an exemplification of the principles of the invention, and is not intended to limit the invention to that as illustrated.

The present invention relates to a cage nut assembly 20. The cage nut assembly 20 includes a nut 22 and a cage 24.

The nut 22 is best illustrated in FIGURES 1 and 2. The nut 22 includes a plate

portion 26, which is preferably rectangular, having a generally planer upper surface 28, a generally planar lower surface (not shown), and sidewalls 32 which connect the upper surface 28 to the lower surface. The nut 22 also includes a second plate portion 34, which is preferably circular, having a generally planar upper surface 36, a generally planar lower surface 38, and a sidewall 40 which connects the upper surface 36 to the lower surface 38. The plate portion 26 and the second plate portion 34 are connected to one another by a cylindrical member 42 which extends between the upper surface 28 of the plate portion 26 and the lower surface 38 of the second plate portion 34. The cylindrical member 42 is preferably in the form of a right circular cylinder. The lower surface 38 of the second plate portion 34 may have protrusions 44 extending therefrom for reasons which will be discussed in more detail herein.

An aperture 46 extends through the nut 22 from the plate portion 26, into the cylindrical member 42, and into the second plate portion 34. The aperture 46 may be closed at the lower surface 30 of the plate portion 26 or it may, preferably, extend all the way through the plate portion 26. The aperture 46 defines an aperture wall 48 which is preferably threaded and is capable of receiving a fastener 50, such as a bolt or a screw, to be attached thereto.

Alternatively, a nut 22a, which may be used in the cage nut assembly 20 rather than the nut 22, is best illustrated in FIGURES 3 and 4. The nut 22a includes a plate portion 26a, which is preferably rectangular, having a generally planer upper surface 28a, a generally planar lower surface (not shown), and sidewalls 32a which connect the upper surface 28a to the lower surface. The nut 22a also includes a second plate portion 34a, which is preferably rectangular, having a generally planar upper surface 36a, a generally planar lower surface 38a, and sidewalls 40a which connect the upper surface 36a to the lower surface 38a. The plate

portion 26a and the second plate portion 34a are connected to one another by a cylindrical member 42a which extends between the upper surface 28a of the plate portion 26a and the lower surface 38a of the second plate portion 34a. The cylindrical member 42a is preferably in the form of a right circular cylinder. The lower surface 38a of the second plate portion 34a may have protrusions 44a extending therefrom for reasons which will be discussed in more detail herein.

An aperture 46a extends through the nut 22a from the plate portion 26a, into the cylindrical member 42a, and into the second plate portion 34a. The aperture 46a may be closed at the lower surface 30a of the plate portion 26a or it may, preferably, extend all the way through the plate portion 26a. The aperture 46a defines an aperture wall 48a which is preferably threaded and is capable of receiving a fastener 50, such as a bolt or a screw, to be attached thereto.

The nut 22, 22a may be formed by cold forming as a one-piece item. Alternatively, it can also be made by staking a cold-headed nut with the circular or rectangular plate feature formed as part of the nut, to a steel plate. The nut 22, 22a may then be heat treated, if desired, depending on the hardness of the material of the nut 22, 22a. While the nut 22a may be used in the cage nut assembly 20 rather than the nut 22, the description of the invention will be discussed with the nut 22 being used in the cage nut assembly 20 with the understanding that the nut 22a would function in a generally identical manner as will the nut 22.

The cage 24 is used for encaging and supporting the nut 22 and is best illustrated in FIGURE 5. The cage 24 has a base portion 52, which is preferably rectangular, such that the base portion 52 has a first side edge 54, a second side edge 56, a third side edge 58 and a fourth side edge 60. The first and third side edges 54, 58 of the base portion 52 are parallel and opposite to one another. The second and fourth side edges 56, 60 of the base portion 52

are parallel and opposite to one another, and are perpendicular to the first and third side edges 54, 58. The base portion 52 has an upper surface 62 and a lower surface 64. An aperture 66 extends through the base portion 52 from the upper surface 62 to the lower surface 64.

A first wall portion 68 extends perpendicularly upwardly from the first side edge 54 of the base portion 52 and extends from a corner 70, which is defined by the connection of the first and second side edges 54, 56, toward a corner 72, which is defined by the connection of the first and fourth side edges 54, 60. The first wall portion 68 extends substantially along a majority of the length of the first side edge 54, from the corner 70 toward the corner 72, but does not extend to the corner 72.

A first arm portion 74 also extends from the first side edge 54 of the base portion 52 and extends from the corner 72 toward the corner 70. The first arm portion 74 has a first portion 76, a second portion 78, a third portion 80 and a fourth portion 82. The first portion 76 of the first arm portion 74 extends perpendicularly upwardly from the first side edge 54 of the base portion 52 such that a gap 77 is formed between the first portion 76 of the first arm portion 74 and the first wall portion 68. The second portion 78 of the first arm portion 74 extends perpendicularly outwardly from the first portion 76 of the first arm portion 74 toward the third side edge 58 of the base portion 52, and is generally parallel to the base portion 52, such that the second portion 78 of the first arm portion 74 has an upper surface 84 which is parallel to the upper surface 62. The third portion 80 of the first arm portion 74 extends perpendicularly outwardly from the second portion 78 of the first arm portion 74 toward the second side edge 56 of the base portion 52, and is generally parallel to the base portion 52, such that the third portion 80 of the first arm portion 74 has an upper surface 86 which is parallel to the upper surface 62. The fourth portion 82 of the first arm portion 74 is generally C-shaped and extends outwardly toward the second side edge 56 of the base portion 52, and is

generally parallel to the base portion 52, such that the fourth portion 82 of the first arm portion 74 has an upper surface 88 which is parallel to the upper surface 62. The first arm portion 74 is formed of a flexible material for reasons which will be discussed further herein.

A second wall portion 90 extends perpendicularly upwardly from the third side edge 58 of the base portion 52 and extends from a corner 92, which is defined by the connection of the third and fourth side edges 58, 60, toward a corner 94, which is defined by the connection of the second and third side edges 56, 58. The second wall portion 90 extends substantially along a majority of the length of the third side edge 58, from the corner 92 toward the corner 94, but does not extend to the corner 94.

A second arm portion 96 also extends from the third side edge 58 of the base portion 52 and extends from the corner 94 toward the corner 92. The second arm portion 96 has a first portion 98, a second portion 100, a third portion 102 and a fourth portion 104. The first portion 98 of the second arm portion 96 extends perpendicularly upwardly from the third side edge 58 of the base portion 52 such that a gap 99 is formed between the first portion 98 of the second arm portion 96 and the second wall portion 90. The second portion 100 of the second arm portion 96 extends perpendicularly outwardly from the first portion 98 of the second arm portion 96 toward the first side edge 54 of the base portion 52, and is generally parallel to the base portion 52, such that the second portion 100 of the second arm portion 96 has an upper surface 106 which is parallel to the upper surface 62. The third portion 102 of the second arm portion 96 extends perpendicularly outwardly from the second portion 100 of the second arm portion 96 toward the fourth side edge 60 of the base portion 52, and is generally parallel to the base portion 52, such that the third portion 102 of the second arm portion 96 has an upper surface 108 which is parallel to the upper surface 62. The fourth portion 104 of the second arm portion 96 is generally C-shaped and extends outwardly toward the fourth side edge 60 of

the base portion 52, and is generally parallel to the base portion 52, such that the fourth portion 104 of the second arm portion 96 has an upper surface 110 which is parallel to the upper surface 62. The second arm portion 96 is formed of a flexible material for reasons which will be discussed further herein.

As illustrated in FIGURE 5, the C-shaped fourth portions 82, 104 of the first and second arm portions 74, 96, respectively, generally form an opening 112 (although not specifically defined as the C-shaped fourth portions 82, 104 do not come into contact with one another to close off the opening 112) therebetween which is generally in alignment with the aperture 66 of the base portion 52 of the cage 24. As will be discussed further herein, the C-shaped fourth portion 82, 104 of the first and second arm portions 74, 96, respectively, support the nut 22.

In operation, the cage 24 is provided and the first arm portion 74 is flexed upwardly such that the first portion 76, the second portion 78, the third portion 80, and the C-shaped fourth portion 82 of the first arm portion 74 are all parallel to one another and are perpendicular to the base portion 52 of the cage 24, as illustrated in FIGURE 6. The nut 22 is then positioned within the cage 24 by placing the second plate portion 34 on the C-shaped fourth portion 104 of the second arm portion 96, such that the lower surface 38 of the second plate portion 34 is positioned on the upper surface 110 of the C-shaped fourth portion 104 of the second arm portion 96.

The first arm portion 74 is then flexed downwardly such that the second portion 78, the third portion 80, and the C-shaped fourth portion 82 of the first arm portion 74 are all parallel to one another and to the base portion 52 of the cage 24, and are perpendicular to the first portion 76 of the first arm portion 74, as illustrated in FIGURE 7. The C-shaped fourth portion 82 of the first arm portion 74 is positioned underneath the second plate portion 34 of

the nut 22, such that the lower surface 38 of the second plate portion 34 is positioned on the upper surface 88 of the C-shaped fourth portion 82 of the first arm portion 74. The opening 112 formed by the C-shaped fourth portions 82, 104 of the first and second arm portions 74, 96 has a diameter which is smaller than a diameter of the second plate portion 34 such that the nut 22 cannot fall through the opening 112.

With the second plate portion 34 being positioned on the C-shaped fourth portions 82, 104 of the first and second arm portion 74, 96, the plate portion 26 is held up off of the upper surface 62 of the base portion 52 of the cage 24, as illustrated in FIGURE 7. The first and second arm portions 74, 96 are formed of a material which is strong enough, without a force being applied thereto, to support the weight of the nut 22, such that the lower surface (not shown) of the plate portion 26 of the nut 22 does not come into contact with the upper surface 62 of the base portion 52 of the cage 24. As illustrated in FIGURE 8, the nut 22 is allowed to float in the "X" and "Y" directions within the opening 112 formed by the C-shaped fourth portions 82, 104 of the first and second arm portions 74, 96 because the cylindrical member 42 of the nut 22 has a diameter which is smaller than the diameter of the opening 112. The aperture 66 of the base portion 52 of the cage 24 is large enough such that the aperture 46 of the nut 22 will always be in communication with the aperture 66 of the cage 24 within the float limitations of the nut 22 defined by the C-shaped fourth portions 82, 104 of the first and second arm portions 74, 96.

The lower surface 64 of the base portion 52 of the cage 24 is then welded to a workpiece 120. The workpiece 120 has an aperture 121 provided therethrough and first and second surfaces 122, 124. The lower surface 64 of the base portion 52 of the cage 24 is welded to the first surface 122 of the workpiece 120 such that the aperture of the workpiece 120 is in communication with the aperture 66 of the base portion 52 of the cage 24, and with

the aperture 46 which extends through the nut 22. The workpiece 120, the cage 24 and the nut 22 are then typically sent through an e-coat or ELPO bath that is meant to add a corrosion or paint coating to the first surface 122 of the workpiece 120. The C-shaped fourth portions 82, 104 of the first and second arm portions 74, 96 support the nut 22 from coming into contact with the upper surface 62 of the base portion 52 of the cage 24, thus reducing the possibility that the cage 24 and the nut 22 will stick or adhere to each other after coating or welding is complete.

It should be noted that if the protrusions 44 are provided on the lower surface 38 of the second plate portion 34, the possibility that the cage 24 and the nut 22 will stick or adhere to each other after coating or welding is complete is reduced even further as the protrusions 44 will allow only minimal contact between the nut 22 and the cage 24 with only the protrusions 44 coming into contact with the upper surfaces 88, 110 of the C-shaped fourth portions 82, 104 of the first and second arm portions 74, 96.

The fastener 50, such as a bolt or a screw, which has a head portion 130 and a threaded shank portion 132 extending therefrom, is then connected to the cage nut assembly 20 and the workpiece 120. The fastener 50 is connected by inserting the threaded shank portion 132 of the fastener 50 through the aperture 121 of the workpiece 120, through the aperture 66 of the base portion 52 of the cage 24 and into the aperture 46 of the nut 22, such that the threaded shank portion 132 of the fastener 50 is threadedly engaged with the aperture wall 48 of the nut 22, until the head portion 130 of the fastener 50 abuts against the second surface 124 of the workpiece 120, as illustrated in FIGURES 9 and 10. The aperture wall 48 may be pre-threaded or the fastener 50 may have a self-tapping thread thereon which forms a thread in the aperture wall 48 of the nut 22.

As the fastener 50 is torqued into place, by threaded engagement with the aperture

wall 48 of the nut 22, the plate portion 26 of the nut 22 is pulled down to interface with the upper surface 62 of the base portion 52 of the cage 24, thus providing a solid joint between the nut 22, the cage 24, the workpiece 120 and the fastener 50. The plate portion 26 is able to be pulled down to interface with the upper surface 62 of the base portion 52 of the cage 24 because the first and second arm portions 74, 96 are flexed downward by a combination of the weight of the nut 22 and the force being applied to the nut 22 by the torqueing of the fastener 50. The flexed first and second arm portions 74, 96 are best illustrated in FIGURE 10.

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Thus, the cage nut assembly 20 provides stronger joints between the nut 22 and the cage 24 than cage nut assemblies of the prior art after the nut 22 is torqued into place. The cage nut assembly 20 also requires less manufacturing and provide for fewer parts than cage nut assemblies of the prior art, thus making the cage nut assembly 20 of the present invention cheaper to make. The nut 22 and the cage 24 of the cage nut assembly 20 also effectively reduce the possibility of the nut 22 sticking to the cage 24 once an e-coat or ELPO bath is applied.

While preferred embodiments of the invention are shown and described, it is envisioned that those skilled in the art may devise various modifications without departing from the spirit and scope of the foregoing description and the appended claims.